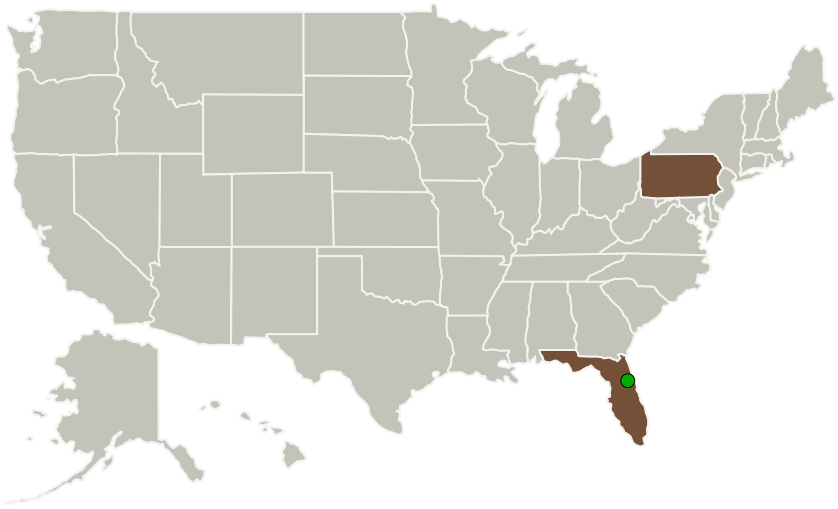
Subsurface Prospecting by Planetary Drones, Phase I

Completed Technology Project (2015 - 2016)

Project Introduction

The proposed program innovates subsurface prospecting by planetary drones to seek a solution to the difficulty of robotic prospecting, sample acquisition, and sample characterization at multiple hazardous locations in a single mission. Innovation focuses on a specific, challenging scenario: sub-surface access of multiple lava tubes by drones far enough from Earth for speed-of-light latency to preclude direct human control. The technology will be broadly applicable to resource prospecting in cold traps, dark craters, cryovolcanoes, asteroids, comets, and other planets. The technology is also applicable to Earth-relevant problems such as the detection of poisonous and explosive gases and flammable dust in mines; and surveying urban canyons; exploring bunkers and caves. The proposed innovation is the development of Anytime Motion Planners that can generate feasible guidance routines to accomplish subsurface prospecting by planetary drones. Anytime Motion Planners are algorithms that can quickly identify an initial feasible plan, then, given more computation time available during plan execution, improve the plan toward an optimal solution. In addition to Anytime Motion Planners, optimal guidance routines will also be innovated in this work by formulating the Generic Autonomous Guidance Optimal Control Problem (Problem G&C) (Pavone, Acikmese, Nesnas, & Starek, 2013) as a convex optimization problem and employing interior-point methods to solve the resulting problem to global optimality. This work will determine whether optimal solutions may be computed quickly enough to be useful in practice.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Astrobotic Technology, Inc.	Lead Organization	Industry	Pittsburgh, Pennsylvania
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Florida	Pennsylvania

Project Transitions

June 2015: Project Start

June 2016: Closed out

Closeout Summary: Subsurface Prospecting by Planetary Drones, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/140790)*

Images

Briefing Chart Image
Subsurface Prospecting by Planetary Drones, Phase I
(https://techport.nasa.gov/image/133196)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Astrobotic Technology, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

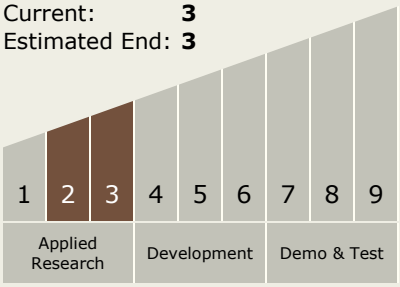
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Kerry Snyder

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.1 Sensing and Perception
    - TX04.1.3 Onboard Mapping and Data Analysis

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System